

Research Article



Fauna of Cestodes of the Mountain Caucasian Ground squirrel and Infestation with Cestodosis in the High-mountain Subzone of the Pricaspian region (Kabardino-Balkarian)

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Abstract | In the high-mountainous territories: Kabardino-Balkaria (the village of Upper Baksan, the village of Elbrus, the a/l Dzhantugan, the village of Tegenekli, the village of Baidaevo, the a/l It-kol, Cheget, Terskol, Azau) in the populations of the Mountain Caucasian ground squirrel, 12 cestode species: *Raillietina* sp., *Rodentolepis straminea*, *Paranoplocephala transversaria*, *Rodentotaenia bondarevae*, *Mathevotaenia symmetrica*, *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata*, *Paranoplocephala dentate*, *Strobilocercus fasciolaris*, *Cysticercus longycollis*, *Alveococcus multilocularis* and *Echinococcus granulosus* larvae, which were recorded with different occurrence values, indexes. Of these, 2 species in the region (*Alveococcus multilocularis*, *Echinococcus granulosus*) have epidemiological and epizootological significance. Indices of occurrence and abundance of cestode *Raillietina* sp. amounted to 6.22% and 7.1±0.6 ind./individual, respectively; species *Rodentotaenia bondarevae* - 3.11% and 3.9±0.4 ind./individual; species *Mathevotaenia symmetrica* - 4.22% and 5.0±0.5 ind./individual; species *Rodentolepis straminea* - 5.11% and 6.4±0.7 ind./individual; species *Skrjabinotaenia lobata* - 2.22% and 4.7±0.5 ind./ind.; species *Cysticercus longycollis* - 4.00% and 3.5±0.4 ind./ind.; species *Strobilocercus fasciolaris* - 2.89% and 2.3±0.3 ind./individual; species *Paranoplocephala transversaria* - 4.67% and 3.8±0.5 ind./individual; species *Paranoplocephala omphalodes* - 3.56% and 2.6±0.3 ind./individual; *Paranoplocephala dentate* - 2.44% and 1.8±0.2 ind./ind.; species *Echinococcus granulosus* larvae - 0.22% and 3.0 ind./ind.; species *Alveococcus multilocularis* larvae - 0.66% and 4.7±0.5 ind./ind. It can be seen that cestodes were found in 450 ind. of dissected Caucasian ground squirrels, 177 ind. (39.33%), with an average II of 4.07 ± 0.41 ind./ind, which indicates the presence of active cestodosis biotopes in the Alpine subzone. Even a weak distribution of alveococcosis and echinococcosis of the Mountain Gopher in the highlands: Kabardino-Balkaria (Upper Baksan, Elbrus, Dzhantugan, Tegenekli village, Baidaevo, It-kol, Cheget, Terskol, Azau) poses an epizootic and epidemic threat to animals and people. It can be seen that cestodes were found in 39.33% of the dissected Mountain Caucasian ground squirrels, with an average II of 8.4 ind./individual, which indicates the unfavorable cestodosis of rodents of the territories: p. Upper Baksan, Elbrus settlement, a/l Dzhantugan, Tegenekli settlement, Baidaevo settlement, a/l It-kol, Cheget, Terskol, Azau. These points belong to the resort and recreational complex and are densely populated areas and require deratization.

Keywords | Pricaspian region, fauna, cestodes, Mountain Caucasian ground squirrel, infestation, indices occurrence, abundance.

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Mountain Caucasian ground squirrel is an endemic of the mountains of the North Caucasus, the number of which has a tendency of uncontrolled growth (Bittirov, 2018; Gazaeva et al., 2018; Shakhbiev et al., 2019). The infestation of the Mountain Caucasian ground squirrel with specific nematode species on the mountain pastures of the Central Caucasus was studied by many authors, according to which EI and AI with 11 specific nematode species varies within 2.7-26.3% and 4-38 ind./individual (Terentyeva et al., 2021; Bittirov et al., 2020; Gazaeva et al., 2020). The species composition of cestodes in the Mountain Caucasian ground squirrel was studied in the territories: Bedik, Bylym, Irik-Chat, Neutrino in the mountain pastures of the region. Here, 4 species of cestodes are dominant - *Paranoplocephala transversaria*, *Rodentotaenia bondarevae*, *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata* (Kabardiev et al., 2019; Arkelova et al., 2022; Bittirov et al., 2021; Gadzhieva et al., 2021). There is information in the literature that on the territory of the Elbrus region, the species *Paranoplocephala omphalodes* was found in the Mountain Caucasian ground squirrel with EI-14.1% with II-3 specimens; in the tract "Bezengi" with EI-18.3% with II-4.1 specimens. (Mirzoeva, et al. 2022; Bittirov et al., 2020; Kabardiev et al., 2020; Kumysheva et al., 2019; Khulamkhanova et al., 2018). In the Mountain Caucasian ground squirrel, the larval stages of the cestode *Alveococcus multilocularis* (Leuckart, 1858), *Echinococcus granulosus larvae* of the suborder *Taeniata* (Skryabin, 1937) (Bittirov et al., 2020; Kumysheva et al., 2019; Chilaev et al., 2018). have also been identified. As can be seen, the infection of the Mountain Caucasian ground squirrel with cestodosis in the Pricaspian region has not been sufficiently studied. The purpose of the work is to study the fauna of cestodes and infection of the Mountain Caucasian ground squirrel with cestodosis in the Pricaspian region (Kabardino-Balkaria).

MATERIALS AND METHODS

The indices of occurrence and abundance of cestode fauna in the Mountain Caucasian ground squirrel in the high-mountain part of the Pricaspian region (Kabardino-Balkaria - Upper Baksan, Elbrus, Dzhantugan, Tegenekli, Baidaevo, It-kol, Cheget, Terskol, Azau) were determined by the method of complete helminthological autopsies (K.I. Skryabin, 1928) internal organs of 450 captured individuals of the Mountain Caucasian ground squirrel. Cestode species from each individual were counted and indices of occurrence and abundance of cestodes were determined: *Raillietina sp.*, *Rodentolepis straminea*, *Paranoplocephala transversaria*, *Rodentotaenia bondarevae*, *Mathevotaenia symmetrica*, *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata*, *Paranoplocephala dentate*, *Strobilocer-*

cus fasciolaris, *Alveococcus multilocularis* 1artcus (Abuladze, 1960) *Cysticercus longycollis* and *Echinococcus granulosus larvae*. The results were statistically processed using the Biometrics program.

RESULTS AND DISCUSSION

Helminthological autopsies according to K.I. Skryabin 450 sets of internal organs of the populations of the Mountain Caucasian ground squirrel, we carried out ecological and epizootic monitoring of the biodiversity of the fauna of cestodes of this type of micromammalia in the high mountain areas: Kabardino-Balkaria (Verkhniy Baksan village, Elbrus village, Dzhantugan village, Tegenekli village, Baidaevo village, a / 1 It-kol, Cheget, Terskol, Azau). During autopsies, 12 species of cestodes were identified: *Raillietina sp.*, *Rodentolepis straminea*, *Paranoplocephala transversaria*, *Rodentotaenia bondarevae*, *Mathevotaenia symmetrica*, *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata*, *Paranoplocephala dentate*, *Strobilocercus fasciolaris*, *Cysticercus longycollis*, *Alveococcus multilocularis* and *Echinococcus* different values of occurrence indices. Of these, 2 species in the region (*Alveococcus multilocularis*, *Echinococcus granulosus*) have epidemiological and epizootological significance (Table 1). In the populations of the Mountain Caucasian ground squirrel, the indices of occurrence and abundance in the high-mountain areas are: Kabardino-Balkaria cestode *Raillietina sp.* amounted to 6.22% and 7.1±0.6 ind./individual, respectively; species *Rodentotaenia bondarevae* - 3.11% and 3.9±0.4 ind./individual; species *Mathevotaenia symmetrica* - 4.22% and 5.0±0.5 ind./individual; species *Rodentolepis straminea* - 5.11% and 6.4±0.7 ind./individual; species *Skrjabinotaenia lobata* - 2.22% and 4.7±0.5 ind./ind.; species *Cysticercus longycollis* - 4.00% and 3.5±0.4 ind./ind.; species *Strobilocercus fasciolaris* - 2.89% and 2.3±0.3 ind./ind.; species *Paranoplocephala transversaria* - 4.67% and 3.8±0.5 ind./ind.; species *Paranoplocephala omphalodes* - 3.56% and 2.6±0.3 ind./ind.; *Paranoplocephala dentate* - 2.44% and 1.8±0.2 ind./ind.; species *Echinococcus granulosus larvae* - 0.22% and 3.0 ind./ind.; species *Alveococcus multilocularis larvae* - 0.66% and 4.7±0.5 ind./ind. (Table 1). It can be seen that cestodes were found in 450 individuals of dissected Caucasian ground squirrels, 177 ind. (39.33%), with an average II of 4.07 ± 0.41 ind./ind., which indicates the presence of active cestodosis biotopes in the Alpine subzone. Even a weak distribution of alveococcosis and echinococcosis of the Mountain Caucasian ground squirrel in the highlands: Kabardino-Balkaria (Verkhny Baksan, Elbrus, Dzhantugan, Tegenekli, Baidaevo, It-kol, Cheget, Terskol, and Azau) poses an epizootic and epidemic threat to animals and humans (Table 1).

Table 1: Cestode fauna of the Mountain Caucasian ground squirrel in the Alpine subzone of the Caspian region (Kabardino-Balkaria) (according to helminthological autopsy of 450 individuals)

| Types of cestodes | Specimens 450 examined/ Infested total, individuals | Occurrence index, % | Abundance in- dex, ind./ind. |
|-----------------------------------|--------------------------------------------------------|------------------------|---------------------------------|
| Raillietina sp. | 28 | 6,22 | 7,1±0,6 |
| Rodentotaenia bondarevae | 14 | 3,11 | 3,9±0,4 |
| Mathevotaenia symmetrica | 19 | 4,22 | 5,0±0,5 |
| Rodentolepis straminea | 23 | 5,11 | 6,4±0,7 |
| Skrjabinotaenia lobata | 10 | 2,22 | 4,7±0,5 |
| Cysticercus longycollis | 18 | 4,00 | 3,5±0,4 |
| Strobilocercus fasciolaris | 13 | 2,89 | 2,3±0,3 |
| Paranoplocephala transversaria | 21 | 4,67 | 3,8±0,5 |
| Paranoplocephala omphalodes | 16 | 3,56 | 2,6±0,3 |
| Paranoplocephala dentate | 11 | 2,44 | 1,8±0,2 |
| Echinococcus granulosus larvae | 1 | 0,22 | 3 |
| Alveococcus multilocularis larvae | 3 | 0,66 | 4,7±0,5 |
| Total: | 450/177 | - | - |
| Average: | -/- | 39,33 | 4,07±0,41 |

Table 2: Indicators of infection of the Mountain Caucasian ground squirrel with cestodosis in the high-mountain subzone of the Caspian region (Kabardino-Balkaria) (According to helminthological autopsy of 450 individuals)

| High Mountain settlements | Specimens 450 examined/ Infested total, individuals | Occurrence index, % | Abundance index, ind./ ind. |
|---------------------------|--------------------------------------------------------|---------------------|--------------------------------|
| Verkhniy Baksan | 22 | 4,89 | 4-17 (10,5) |
| Elbrus | 19 | 4,22 | 2-14 (8,0) |
| Dzhantugan | 15 | 3,33 | 3-11 (7,0) |
| Tegenekli | 20 | 4,44 | 1-13 (7,0) |
| Baidaevo | 21 | 4,67 | 2-15 (8,5) |
| It-kol | 23 | 5,11 | 3-12 (7,5) |
| Cheget | 19 | 4,22 | 2-16 (9,0) |
| Terskol | 20 | 4,44 | 2-19 (10,5) |
| Azau | 18 | 4,00 | 1-14 (7,5) |
| Total: | 450/177 | - | - |
| Average: | -/- | 39,33 | 1-19 (8,4) |

According to helminthological autopsies according to K.I. Skryabin (1928) using 450 sets of internal organs of populations of the Mountain Caucasian ground squirrel, we conducted an epizootic monitoring of the spread of cestodosis in the form of mixed invasion of 2-6 species in various spontaneous combinations of 12 species of cestodes: Raillietina sp., Rodentolepis straminea, Paranoplocephala transversaria, Rodentotaenia bondarevae, Mathevotaenia symmetrica, Paranoplocephala omphalodes, Skrjabinotaenia lobata, Paranoplocephala dentate, Strobilocercus fasciolaris, Cysticercus longycollis, Alveococcus multilocularis and Echinococcus granulosus in mountain areas: p. Upper Baksan, Elbrus settlement, Dzhantugan, Tegenekli settlement, Baidaevo settlement, a/l It-kol, Cheget, Terskol, Azau. In these 9 settlements, the values of the indices of

occurrence and abundance differed little (Table 2). Indices of occurrence and abundance of cestodosis in the populations of the Mountain Caucasian ground squirrel in the territory of the village. Upper Baksan: amounted to 4.89% and 4-17 (average 10.5) ind./individual, respectively; Elbrus settlement - 4.22% and 2-14 (8.0) ind./individual; a/l Dzhantugan - 3.33% and 3-11 (7.0 ind./individual); Tegenekli village - 4.44% and 1-13 (7.0) ind./individual; Baidaevo village - 4.67% and 2-15 (8.5) ind./ind.; a/l It-kol - 5.11% and 3-12 (7.5) ind./individual; t/c Cheget - 4.22% and 2-16 (9.0) ind./individual; Terskol settlement - 4.44% and 2-19 (10.5) ind./individual; t/c Azau - 4.00% and 1-14 (cf. 7.5) ind./individual.

It can be seen that cestodes were found in 39.33% of the dissected Mountain Caucasian ground squirrels, with an average II of 8.4 ind./individual, which indicates that rodents in high mountain areas are unfavorable in terms of cestodosis: p. Upper Baksan, Elbrus, Dzhantugan, Tegenekli, Baidaevo, It-kol, Cheget, Terskol, Azau (Table 2). These settlements belong to the resort and recreational complex and are densely populated areas and require deratization.

CONCLUSION

In the high-mountainous territories: Kabardino-Balkaria (the village of Upper Baksan, the village of Elbrus, the a/l Dzhantugan, the village of Tegenekli, the village of Baidaevo, the a/l It-kol, Cheget, Terskol, Azau) in the populations of the Mountain Caucasian ground squirrel, 12 cestode species: *Raillietina* sp., *Rodentolepis straminea*, *Paranoplocephala transversaria*, *Rodentotaenia bondarevae*, *Mathevotaenia symmetrica*, *Paranoplocephala omphalodes*, *Skrjabinotaenia lobata*, *Paranoplocephala dentate*, *Strobilocercus fasciolaris*, *Cysticercus longycollis*, *Alveococcus multilocularis* and *Echinococcus granulosus* larvae, which were recorded with different occurrence values, indexes. Of these, 2 species in the region (*Alveococcus multilocularis*, *Echinococcus granulosus*) have epidemiological and epizootological significance. Indices of occurrence and abundance of cestode *Raillietina* sp. amounted to 6.22% and 7.1 ± 0.6 ind./individual, respectively; species *Rodentotaenia bondarevae* - 3.11% and 3.9 ± 0.4 ind./individual; species *Mathevotaenia symmetrica* - 4.22% and 5.0 ± 0.5 ind./individual; species *Rodentolepis straminea* - 5.11% and 6.4 ± 0.7 ind./individual; species *Skrjabinotaenia lobata* - 2.22% and 4.7 ± 0.5 ind./individual; species *Cysticercus longycollis* - 4.00% and 3.5 ± 0.4 ind./individual; species *Strobilocercus fasciolaris* - 2.89% and 2.3 ± 0.3 ind./individual; species *Paranoplocephala transversaria* - 4.67% and 3.8 ± 0.5 ind./individual; species *Paranoplocephala omphalodes* - 3.56% and 2.6 ± 0.3 ind./individual; *Paranoplocephala dentate* - 2.44% and 1.8 ± 0.2 ind./individual; species *Echinococcus granulosus* larvae - 0.22% and 3.0 ind./individual; species *Alveococcus multilocularis* larvae - 0.66% and 4.7 ± 0.5 ind./individual. It can be seen that cestodes were found in 450 individuals of dissected Caucasian ground squirrels, 177 individuals (39.33%), with an average II of 4.07 ± 0.41 ind./individual, which indicates the presence of active cestodosis biotopes in the Alpine subzone. Even a weak distribution of alveococcosis and echinococcosis of the Mountain Gopher in the highlands: Kabardino-Balkaria (Upper Baksan, Elbrus, Dzhantugan, Tegenekli, Baidaevo, It-kol, Cheget, Terskol, Azau) poses an epizootic and epidemic threat to animals and people. It can be seen that cestodes were found in 39.33% of the dissected Mountain Caucasian ground squirrels, with an

average II of 8.4 ind./individual, which indicates the unfavorable cestodosis of rodents of the territories: p. Upper Baksan, Elbrus, Dzhantugan, Tegenekli, Baidaevo, a/l It-kol, Cheget, Terskol, Azau. These points belong to the resort and recreational complex and are densely populated areas and require deratization.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

NOVELTY STATEMENT

The authors declare that the results obtained on the topic of the article were obtained empirically, and the reflected information is new for science in the field of parasitology.

AUTHORS' CONTRIBUTION

All authors took part in the study and identification of the biodiversity of the fauna of cestodes in the Mountain Caucasian ground squirrel and infestation with cestodosis in the high-mountain subzone of the Caspian region (Kabardino-Balkaria), collected materials, analyzed the material, and participated in writing the manuscript. Collectively reviewed the manuscript. All authors read and approved the final version of the manuscript.

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